No English title available.

Patent Number: GB1243898
Publication date: 1971-08-25
Inventor(s):
Applicant(s):
Requested Patent: GB1243898
Application Number: GBD1243898 19691107
Priority Number (s): DE19681808022 19681109; DE19691903799 19690125; DE19691914117 19690320
IPC Classification:
EC Classification: F24D13/02, H05B3/14P, H05B3/34B
Equivalents: BE741021, CA921090, CH491576, DK130940B, DK130940C, FR2022946, JP51006369B, NL142559B, NL6916451, NO130884B, NO130884C

Abstract

1,243,898. Laminated heating elements. KABEL - UND METALLWERKE GUTE- HOFFNUNGSHUTTE A.G. 7 Nov. 1969 [9 Nov., 1968; 25 Jan., 1969; 20 March, 1969], No. 54657/69. Heading B5N. [Also in Division H5] A flexible electric surface-heating element includes a conductive polyester fleece 1 with two or more metal terminal strips 2, 3, 6, and enclosing insulation which may be two insu- lating fibre fleeces 4, 5, with their inner sides provided with an adhesive coating for holding the element assembly together. Alternatively, the insulation is provided by two plastics foils 9, 10, Fig. 6 (not shown), provided with heat- sealable coatings, for example polyester foils coated with polyethylene or polyimide foils coated with a tetrafluoroethylene-perfluoro- propylene copolymer. Additional metal foils 7, 8 may be secured to the element, e.g. using adhesive or a thin polyethylene sheet which melts on the application of mechanical pressure and an elevated temperature. One or both foils 7, 8 are connected to earth and a " wrong- voltage" cut-out interrupts the supply of current to the heating element if the element is damaged, e.g. by nails driven in it. Three terminal strips 2, 3, 6, are provided at differing distances apart to give greater heating of surface B than surface A. With two strips 2, 3, they may be parallel to the sides of the heating element or inclined to one another, Fig. 4 (not shown), so that heating increases continu- ously from one end of the element to the other. Strips 2, 3 are of perforated copper so that leads are attachable thereto easily, e.g. by rivets. Applications of the surface heating element for heating walls, ceilings, floors, under fitted carpets or plastics or parquet floor-coverings are mentioned, and use in heated foot-mats or hot-plates for food. The insulation layers 4, 5 may be transparent or translucent.

1 243 898

PATENT SPECIFICATION

(11) 1 243 898

DRAWINGS ATTACHED

(21) Application No. 54657/69 (22) Filed 7 Nov. 1969

(31) Convention Application Nos. P 18 08 022.3 (32) Filed 9 Nov. 1968
P 19 03 799.1 25 Jan. 1969
P 19 14 117.4 20 March 1969 in

(33) Germany (DT)

(45) Complete Specification published 25 Aug. 1971

(51) International Classification H 05 b 3/38

(52) Index at acceptance

H5H 1B 1C 1D1 1E 2E4C 2E4X 3C 3D 3T
B5N 177 178 17X 17Y 227 228 22X 22Y 234 249 250 252X 252Y 280X 281X 282X 285X 286X 290Y 297Y 309Y 344 348 35X 428 42X 436 439 55Y 574 582 587 588 590 609 615 61Y 621 627 632 634 63X 644 648 668 670 679 682 68X 690 69Y 713 71X 75X 75Y 779 79X

(72) Inventor GERALD KUHM

(54) FLEXIBLE ELECTRIC SURFACE HEATING ELEMENT ASSEMBLY

(71) We, KABEL- UND METALLWERKE GUTEHOFFNUNGSHUTTE AKTIENGESELLSCHAFT, a body corporate organised under the Laws of Germany, of Postfach 260, Vahrenwalder Strasse 271, 3000 Hannover, Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to flexible electric surface heating element assemblies comprising a resistor constituting the heating element proper and conductor means connecting a current source with the resistor. It will be understood that the electric current is converted into heat in the resistor.

For the heating of indoor spaces and exposed surfaces, a number of fixed surface heating systems are known in which electrical energy supplied thereto is converted into heat by means of resistance wires having a heat-resistant insulation of rubber or plastics, the resistance wires being laid in loops and linked up to form mats. Woven fabrics composed of plastics filaments or metal wires with bare or insulated heating conductors woven in are also known, and these fabrics are utilised by (*inter alia*) incorporation in removable surface heaters.

These two types of partly rigid, partly flexible heating mats have a number of disadvantages. Temperature distribution is irregular, with relatively high temperatures near the resistors and low temperatures in the parts between the resistors. The method of manufacture entails a relatively high proportion of hand work and is therefore complicated and expensive. It is difficult to provide for adjustment to give different heat outputs per unit surface area, because the mains voltage is fixed, so that the adjustment can only be effected by altering the distances between, the lengths of, or the construction of the resistance wires. In addition, the resistance wires must be provided with non-heated leads to the terminal boxes.

Wall heating mats are also known which have heating wires embedded in cellular plastics material and disposed in loops, and temperature-equalising metal foils secured by adhesive bonding in positions between the heating wires. The preparation of the wires is expensive, however, and so is the assembly of the individual heating loops, which are connected in parallel, to form a single heating unit. The great thickness of these mats must also be regarded as a particular disadvantage.

In addition, metal foils are known, which in their longitudinal direction are slotted or provided with apertures in such a manner that loop-like conductor strips are formed between two longitudinal outer strips, and are heated in the desired manner when a voltage is applied. These foils have the disadvantages that manufacture is slow and that zones of high temperature and zones of low temperature alternate, and further that different heating outputs can be obtained only by modifying the cutting or stamping tool. In addition, with this type of heating foil, there is a considerable risk of breakage and short-circuiting because of the poor mechanical strength.

In addition, fabrics of textile or glass fibres which have been made conductive are known for heating purposes, these being fabrics which utilise for the purpose of heating the electrical conductivity of thin carbon or graphite coatings. The slowness of the

weaving operation makes such heating elements expensive to manufacture, and the process of applying metal coatings to them by spraying is complicated and electrically uncertain, particularly when bending stresses occur.

It is an object of the present invention to provide a surface heating element assembly in which the above described disadvantages do not occur and which has a thickness that will enable the assembly to be used under wall surfacings without making its presence immediately obvious from the outside.

According to the present invention, we provide a flexible electric surface heating element assembly comprising a resistor constituting the heating element proper and conductor means connecting a current source with the resistor, in which the resistor is an electrically conductive polyester fleece (as herein defined) and the conductor means comprise metal strips applied to the polyester fleece, the metal strips (or two of them if there are three or more) lying adjacent to two opposite edges of the polyester fleece, and the polyester fleece and the metal strips being completely enclosed by insulating fibre fleeces (as herein defined) provided on one side with an adhesive coating, and being thereby held together.

The conductive polyester fleece used need not be of great thickness, but it can still have good mechanical strength and stability of shape, and in addition be highly flexible. Moreover, over a wide temperature range it has a substantially constant electrical resistance, and it can without difficulty be manufactured in great lengths. A secure connection and consequently good contact between the conductive polyester fleece and the metal strips is ensured by the use of the insulating fibre fleeces which are adhered to them on both sides, and which for example can be permanently bonded to the conductive polyester fleece by the action of heat with the simultaneous application of mechanical pressure. In order to improve contact, according to one preferred feature of the invention, the metal strips may be perforated; the perforations are advantageously disposed away from the centre of the strip, on the side of the latter which is nearer the centre of the heating element. The conductive polyester fleece and the insulating fibre fleece lying on the same side of it as the metal strip in question are thus joined together directly at these perforations.

The invention is illustrated in the accompanying drawings, in which:

Figure 1 is a plan view of a portion of a surface heating element assembly according to the invention,

Figure 2 shows a section through Figure 1 along the line II—II, the thickness of the heating element being greatly exaggerated for the sake of better understanding,

Figures 3 and 4 are plan views of portions of two further forms of surface heating element assembly according to the invention, and

Figures 5 and 6 are sectional views of two still further forms of surface heating element assembly according to the invention.

In Figures 1 and 2, 1 designates the conductive polyester fleece which is used as a resistor and along whose sides two metal strips 2 and 3 are disposed. These metal strips, which may for example be of copper, are of such dimensions that on the one hand they do not increase the thickness of the surface heating element assembly and that on the other hand they themselves will be heated only slightly. 4 and 5 designate two insulating fibre fleeces which enclose the polyester fleece and the metal strips 2 and 3. The inner sides of the fibre fleeces 4 and 5 are provided with an adhesive coating, and thus the surface heating element assembly is complete after they have been applied.

The metal strips 2 and 3 are preferably applied to the polyester fleece with their outer edges in line with the outer edges of the fleece. To enable the surface heating element assembly to be connected to the mains or other supply, the two metal strips protrude from the fleece, so that leads can be directly coonnected to them.

It is also possible for additional layers or foils of transparent or non-transparent material to be provided over the insulating fibre flleeces. If, however, the layers comprising the fibre fleeces are of transparent or translucent material, it is easy to check whether the metal strips are making contact as required.

Because a surface heating element assembly according to the invention need not be thick, a large number of uses are possible. In particularly, the assembly can be produced in any desired length with a fixed width corresponding with the desired heat output. The following may be listed as examples of its application. Installation as a ceiling heater or as a wall heater under a thin wall-surfacing (in such a case the transition between a heated middle zone of a wall and a non-heated marginal zone is impercaptible); installation as a floor heater under a plastics or parquet floor-covering, or under a fitted carpet; construction of heated foot mats of relatively small dimensions; installation in hotplates for food. For most installations it is possible to use ordinary adhesives which adhere well to the outer fibre fleece layers 4 and 5.

In special cases more than two metal contact strips may be disposed on a con-

tinuous layer of conductive polyester fleece, e.g. when a greater width of heating element is desired, or when two heating surfaces of different heating outputs are to be disposed side by side. Figure 3 illustrates one arrangement of this type. If a voltage is applied to the arrangement of Figure 3 in such a manner that the metal contact strips 2 and 6, for example, are connected to the "neutral" wire, and the contact strip 3 is connected to the "line", the surface A will, because of the greater distance between the strips 2 and 3, be heated less than the surface B in which the distance between the strips 3 and 6 is shorter.

In another special case, which is illustrated in Figure 4, the metal contact strips may be non-parallel, i.e. disposed at an angle to one another, in the plane of the conductive polyester fleece 1; this arrangement is useful when heating is required to increase continuously from one side of the surface heating element. When a voltage is applied to the arrangement of Figure 4, greater surface heating occurs in the region of "D" than in the region of "C", with a stepless transition between the two temperature regions.

In a further specific arrangement in accordance with the present invention, a metal foil connected to an "earth" or other protective contact of the current source is provided over at least one side of the polyester fleece.

It is an advantage of this arrangement that if the assembly is badly damaged, e.g. by nails being driven into it, the person causing the damage, e.g. driving in the nails, will not receive a shock. The purpose of connecting the metal foil, which is preferably of aluminium, to the "earth" or other protective conductor of the current source is to ensure that every metal object touching the metal foil is at zero potential. By means of an ordinary "wrong voltage" cut-out it is in addition possible, in accordance with another preferred feature of the invention, to interrupt the supply of current to the surface heating element assembly when damage has occurred, in order to avoid further damage, for example through increased local heating.

An assembly using metal foil as just described is shown in Figure 5, in cross-section. In Figure 5, 1 designates the conductive polyester fleece, on which lie metal strips 2 and 3 which serve to supply current to the polyester fleece 1. The polyester fleece and metal strips are enclosed by insulating fibre fleeces 4 and 5, which on one side are provided with an adhesive coating. According to the present embodiment of the invention, a metal foil is disposed over the insulating fibre fleeces, at least on one side of the surface heating element, and in the case of Figure 5, the metal foil is disposed on both sides of it, being designated by the reference 7 on one side and by the reference 8 on the other. If the metal foil is disposed only on one side, it is advisable that this side should face away from the support on which the surface heating element assembly is mounted. Contact with the metal foil can be made with a thin metal strip, which is preferably disposed approximately centrally between the two current supply strips 2 and 3 for the conductive polyester fleece.

The aluminium foil may be secured to the rest of the heating element assembly by means of an ordinary adhesive or by means of a thin sheet of (e.g.) polyethylene, which melts on the application of mechanical pressure and an elevated temperature, thus producing an adhesive bond between the aluminium foil and the rest of the heating element assembly.

The thickness of the assembly is increased only imperceptibly by the two additional metal foils, so that its flexibility and in particular its ability to be rolled up are hardly reduced at all. For the sake of clarity the thickness of the individual elements has been greatly exaggerated in Figure 5.

In a still further specific arrangement in accordance with the invention, the assembly is modified in that the insulating material is in the form of plastics foils provided on one side with a heat-sealable coating. The plastics foils may for example be in the form of polyester foils coated with polyethylene, or of a polyimide foil coated with a tetrafluoroethylene-perfluoropropylene copolymer.

It is an advantage of this last-mentioned specific arrangement that the plastics foils can have great mechanical strength, good dielectric strength for A.C. or D.C., and low permeability to water vapour, thus permitting the construction of a surface heating element assembly which can withstand relatively great mechanical stresses during installation and is also suitable for heating damp rooms. Another advantage of the use of these plastics foils is that when the surface heating element assembly is installed, for example on a wall, it is possible to use adhesives having a high water content, like ordinary wallpaper paste, without any risk that the moisture will penetrate into the conductive polyester fleece. In addition, the foils increase the stability of shape and rollability of the assembly; they also give more reliable contact between the metal strips and the conductive polyester fleece, because of their particularly good adhesive properties after heat sealing.

An assembly using plastics foils as just described is shown in Figure 6, in cross-section.

1243898 COMPLETE SPECIFICATION
3 SHEETS This drawing is a reproduction of the Original on a reduced scale
Sheet 1

FIG.1.

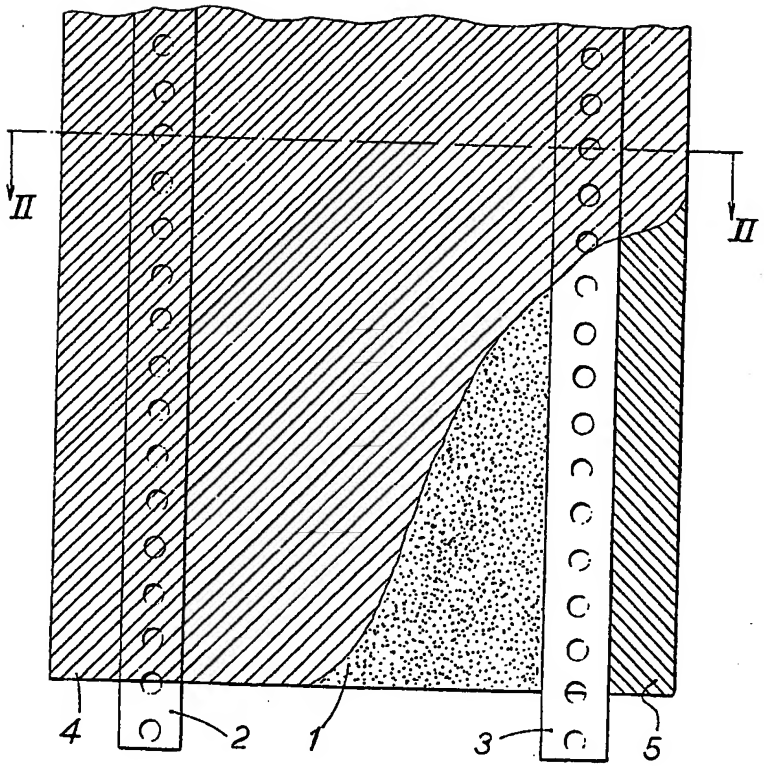

FIG.2.

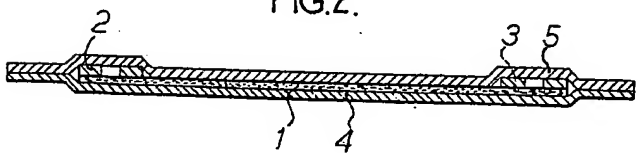

FIG.3.

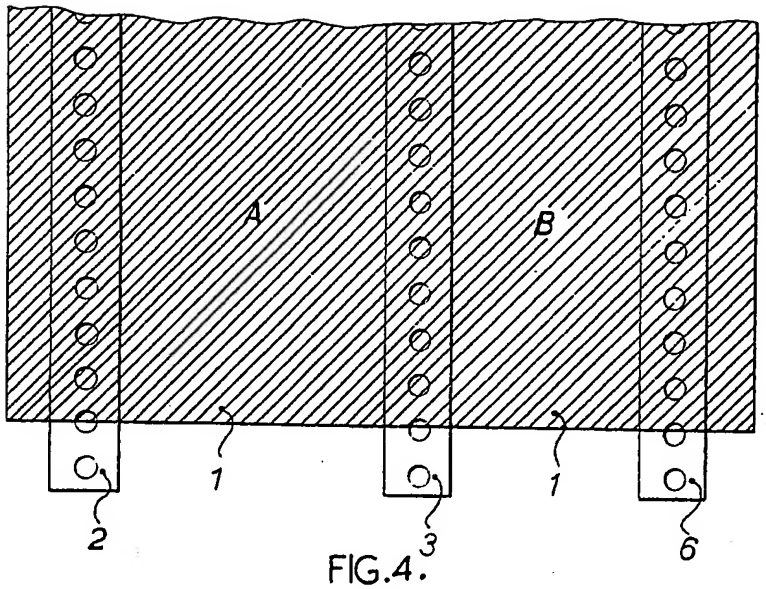

FIG.4.

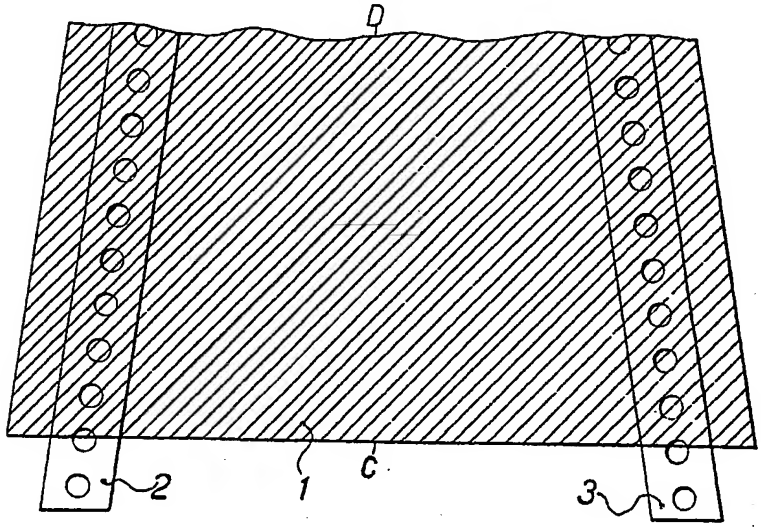

FIG.5.

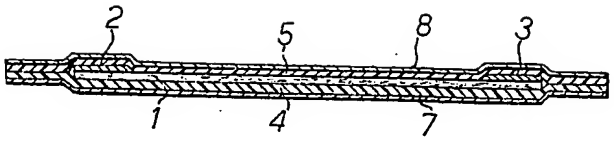

FIG.6.